CLAIMS

1. A relay telescope for high-powered laser systems, comprising:

a first relay lens;

a second relay lens;

a vacuum chamber between the first and second relay lenses, the first and second relay lenses focusing beams at a common focal point within the vacuum chamber;

a kinematic mount within the vacuum chamber, adapted to secure beam baffles near the common focal point; and

an access port on the vacuum chamber, adapted for insertion and removal of beam baffles.

2. The telescope of claim 1, including a baffle adapted to be mounted in said kinematic mount, said baffle comprising a solid member having an optically transparent channel, the optically transparent channel having openings on opposite ends of the solid member, and a waist within the solid member near said telescope focal point, said waist being smaller than said openings, and said channel having sides which taper near said waist.

3. The telescope of claim 1, including a baffle adapted to be mounted in said kinematic mount, said baffle comprising a solid member having an optically transparent channel, the optically transparent channel having openings on opposite ends of the solid member, and a waist within the solid member near said telescope focal point, said waist being smaller than said openings, and said channel having sides which taper near said waist at a grazing angle in a range of about 1 to 10 degrees.

4. The telescope of claim 1, including a baffle adapted to be mounted in said kinematic mount, said baffle comprising a solid member having a channel defined by a hollow in said member, the channel having openings on opposite ends of the solid

member, and a waist within the solid member near said telescope focal point, said waist being smaller than said openings, and said channel having sides which taper near said waist.

5. The telescope of claim 1, including a baffle adapted to be mounted in said kinematic mount, said baffle comprising a solid member having a channel defined by a hollow in said member, the channel having openings on opposite ends of the solid member, and a waist within the solid member near said telescope focal point, said waist being smaller than said openings, and said channel having sides which taper near said waist at a grazing angle in a range of about 1 to 10 degrees.

6. The telescope of claim 1, including a far-field, tapered baffle adapted to be mounted in said kinematic mount, said far-field, tapered baffle comprising a solid member having an optically transparent channel, the optically transparent channel having openings on opposite ends of the solid member, and a waist within the solid member near said telescope focal point, said waist being smaller than said openings, and said channel having sides which taper near said waist; and

a far-field alignment baffle adapted to be mounted in said kinematic mount, said alignment baffle comprising a pinhole aperture.

7. The telescope of claim 1, including a near-field baffle mounted adjacent one of said first and second relay lenses.

8. The telescope of claim 1, including a first near-field baffle mounted adjacent said first relay lens, and a second near-field baffle mounted adjacent said second relay lens to block stray beams.

9. A laser amplifier, comprising:

a gain medium;

a polarization rotator;

a passive polarizer;

a plurality of reflectors configured to define an optical path through the gain medium, the passive polarizer, and the polarization rotator; and

a phase conjugator configured to receive a beam from the optical path after the pulse has proceeded one or more transits through the optical path, the phase conjugator further configured to return the beam with reversed phase to the optical path to proceed an equal number of transits of the optical path in an opposite direction before exiting the optical path; and

a relay telescope having a telescope focal point, between the gain medium and the passive polarizer, which is used for relaying images between the gain medium and a location in the optical path near the passive polarizer, having a baffle near said telescope focal point to block off angle beams, the baffle comprising a solid member having an optically transparent channel, the optically transparent channel having openings on opposite ends of the solid member, and a waist within the solid member near said telescope focal point, said waist being smaller than said openings, and said channel having sides which taper near said waist.

10. The system of claim 9, wherein said channel has sides which taper near said waist at a grazing angle in a range of about 1 to 10 degrees.

11. The system of claim 9, wherein said channel comprises a hollow in said member.

12. The system of claim 9, wherein said optical cavity is aligned with walk off so that stray beams that transit the optical cavity more times than specified are blocked by said baffle.

13. The system of claim 9, wherein said optical cavity is aligned with walk off so that stray beams that transit the optical cavity more times than specified are blocked by said baffle.

14. The system of claim 9, wherein said location in the optical path is adjacent the polarization rotator and the passive polarizer.

15. The system of claim 9, including a second relay telescope in the optical path to relay images between said location and the phase conjugator.

16. The system of claim 9, including a second relay telescope in the optical path to relay images between said location and the phase conjugator, the second relay telescope having a baffle which blocks off angle beams.

17. A laser amplifier, comprising:

a gain medium;

a polarization rotator;

a passive polarizer;

a plurality of reflectors configured to define an optical path through the gain medium, the passive polarizer, and the polarization rotator; and

a phase conjugator configured to receive a beam from the optical path after the pulse has proceeded one or more transits through the optical path, the phase conjugator further configured to return the beam with reversed phase to the optical path to proceed an equal number of transits of the optical path in an opposite direction before exiting the optical path; and

a relay telescope having a telescope focal point, between the gain medium and the passive polarizer, which is used for relaying images between the gain medium and a location in the optical path near the passive polarizer, the relay telescope comprising

a first relay lens;

a second relay lens;

a vacuum chamber between the first and second relay lenses, the first and second relay lenses focusing beams at a common focal point within the vacuum chamber;

a kinematic mount within the vacuum chamber, adapted to secure beam baffles near the common focal point; and

an access port on the vacuum chamber, adapted for insertion and removal of beam baffles.

18. The system of claim 17, including a baffle adapted to be mounted in said kinematic mount, said baffle comprising a solid member having an optically transparent channel, the optically transparent channel having openings on opposite ends of the solid member, and a waist within the solid member near said telescope focal point, said waist being smaller than said openings, and said channel having sides which taper near said waist.

19. The system of claim 17, including a baffle adapted to be mounted in said kinematic mount, said baffle comprising a solid member having an optically transparent channel, the optically transparent channel having openings on opposite ends of the solid member, and a waist within the solid member near said telescope focal point, said waist being smaller than said openings, and said channel having sides which taper near said waist at a grazing angle in a range of about 1 to 10 degrees.

20. The system of claim 17, including a baffle adapted to be mounted in said kinematic mount, said baffle comprising a solid member having a channel defined by a hollow in said member, the channel having openings on opposite ends of the solid member, and a waist within the solid member near said telescope focal point, said waist being smaller than said openings, and said channel having sides which taper near said waist.

21. The system of claim 17, including a baffle adapted to be mounted in said kinematic mount, said baffle comprising a solid member having a channel defined by a hollow in said member, the channel having openings on opposite ends of the solid member, and a waist within the solid member near said telescope focal point, said waist being smaller than said openings, and said channel having sides which taper near said waist at a grazing angle in a range of about 1 to 10 degrees.

22. The system of claim 17, including a far-field, tapered baffle adapted to be mounted in said kinematic mount, said far-field, tapered baffle comprising a solid member having an optically transparent channel, the optically transparent channel having openings on opposite ends of the solid member, and a waist within the solid member near said telescope focal point, said waist being smaller than said openings, and said channel having sides which taper near said waist; and

a far-field alignment baffle adapted to be mounted in said kinematic mount, said alignment baffle comprising a pinhole aperture.

23. The system of claim 17, including a near-field baffle mounted adjacent one of said first and second relay lenses.

24. The system of claim 17, including a first near-field baffle mounted adjacent said first relay lens, and a second near-field baffle mounted adjacent said second relay lens to block stray beams.

25. The system of claim 17, wherein said optical cavity is aligned with walk off so that stray beams that transit the optical cavity more times than specified are blocked by a baffle in said kinematic mount.

26. The system of claim 17, wherein said location in the optical path is adjacent the polarization rotator and the passive polarizer.

27. The system of claim 17, including a second relay telescope in the optical path to relay images between said location and the phase conjugator.

28. The system of claim 17, including a second relay telescope in the optical path to relay images between said location and the phase conjugator, the second relay telescope having a baffle which blocks off angle beams.

29. A method for laser shock peening a target work piece, comprising:

coupling a seed pulse into a ring shaped optical path including an amplifying medium;

first relaying an image of an output of the amplifying medium to an SBS phase conjugation system;

phase reversing the pulse in the SBS phase conjugation system after one or more transits through the ring in which the pulse traverses the amplifying medium;

second relaying an image of the output of the amplifying medium between an output coupler, after the pulse traverses the amplifying medium in an equal number of transits through the ring in an opposite direction to provide a wavefront corrected output pulse;

coupling the wavefront corrected output pulse comprising the image of the output of the amplifying medium out of the ring at the output coupler, and

controlling a pulse width of the wavefront corrected output pulse by controlling a threshold of said SBS phase conjugation system; and

delivering the wavefront corrected output pulse to the target work piece,

wherein said first and second relaying includes using one or more intra-cavity relay telescopes, and a tapered baffle in a telescope focal point in at least one of the one or more relay telescopes to block off angle beams.

30. The method of claim 29, wherein said SBS phase conjugation system comprises a collimated SBS cell and a focused SBS cell in the optical path.

31. The method of claim 29, wherein said SBS phase conjugation system comprises a collimated SBS cell and a focused SBS cell in the optical path, and said controlling the pulse width includes diverting a controlled amount of energy from said pulse out of the cavity between the collimated SBS cell and the focused SBS cell to control said threshold.

32. The method of claim 29, wherein said SBS phase conjugation system an SBS medium in said optical path, the SBS medium comprising a compound having an non-linear index of refraction of less than about 10^{-12} esu.

33. The method of claim 29, wherein said SBS phase conjugation system includes an SBS medium in said optical path, and including filtering said SBS medium *in situ* to remove particles having a size greater than about 0.1 microns.

34. The method of claim 29, wherein said SBS phase conjugation system includes a collimated SBS cell and a focused SBS cell in the optical path; and

aligning the optical path using an alignment fiducial between the collimated SBS cell and the focused SBS cell.

35. The method of claim 29, including aligning at least one of said one or more relay telescopes by first inserting a pinhole baffle at the telescope focal point, and aligning the relay telescope, and then replacing the pinhole baffle with said tapered baffle.

36. The method of claim 29, wherein said tapered baffle comprises a solid member having an optically transparent channel, the optically transparent channel having

openings on opposite ends of the solid member, and a waist within the solid member near said telescope focal point, said waist being smaller than said openings, and said channel having sides which taper near said waist at a grazing angle in a range of about 1 to 10 degrees.